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INNOVATION IN PRIMARY ROAD PROGRAM IN DELAWARE

by Richard A. Haber

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INNOVATION IN PRIMARY ROAD PROGRAM IN DELAWARE

Richard A. Haber

The State of Delaware is in a unique geographical position between the States of New Jersey, Pennsylvania, Maryland and Virginia, which causes our Highway system to be used as a connecting link between the major cities of these adjoining states and gives an overall traffic picture, in which 50 to 52 per cent of all traffic on our major arteries is out of State registration. We have been referred to as "The Cross Roads of the East" and the name is even more fitting than ever now that the Delaware River is crossed by the Delaware-Memorial Bridge (Fig. 1). The building of this suspension structure has been described at the New York meeting of this society by members of the Consulting Engineers who were responsible for its design and construction. It has a center span of 2150′ and an overall length of 10,765′ between abutments, four travel lanes with a dividing strip in the center. In its first year of operation it carried in excess of six million vehicles and in this its second year will surpass seven and one-half million vehicles. Over the bridge itself, the traffic consists of 89% out-of-State registrations. The continued increase in the use of this crossing because of its direct connection with the New Jersey Turnpike and with U. S. 40, the direct route to Baltimore and Washington, has far surpassed the anticipated traffic figures and ever since the day the Bridge was opened additional facilities at the toll plaza are being added. It has been necessary to increase the number of booths from six to twelve, a complete new Maintenance center and Information center has been added, partial clover leaf intersections have been completed to full clover leaf and already we are being forced to provide an additional approach on the Delaware side to by-pass the old duPont highway. This existing Parkway is now three lanes in each direction with a seventy-foot centermall but is heavily built up on both sides and is carrying a traffic load of 60,000 vehicles per day which is over-taxing its capacity because of the amount of cross-traffic through the housing developments which flank it. With fast through traffic to handle, not only at this location but throughout the State, we have attempted to make the best possible use of new highway thinking and to develop design and construction methods to achieve the best investment for our highway dollar. This thinking does not necessarily indicate the lowest initial cost, but is considered on the basis of maintenance, economics and overall expected life of the project. Under the bridges of new interchange at the intersection of U. S. 13 and 40 we have placed Belgian Block rip-rap with materials salvaged from City street work in nearby Wilmington. These blocks were placed on a sand clay blanket by hand with grout broomed into the intersices to form a solid cemented blanket on the weather slope of the bridge. We feel that this type of construction will last indefinitely. The appearance of this work is very pleasing and adds to the overall beauty of the interchange. Another first which we have attempted this past year are overhead directional signs of the bridge type. The frames are heavier than is usual and are designed as a true bridge structure to prevent overturning and to resist impact if struck. The sign itself has a dark blue porcelain front with gold plastic

letters enclosing white florescent tubes. When lighted the signs are the blue and gold State colors with excellent visibility, and because of the thickness of the plastic shell do not show the individual lighting tubes. The contrast in color also provides readability during daylight hours without the use of electricity.

One of our major jobs which is still under construction is the rebuilding of U. S. 202. The maximum grade is 7-1/2% and because of icy conditions and the consequent use of salt and chemicals all work is with air-entrained cement. The typical section of improvement shows two 24-foot divided lanes of 9" reinforced concrete with a four-foot light reflecting concrete curb divider and two seven-foot parking lanes of hot-mix bituminous concrete on stone base with intergral curb and gutter and sidewalk for a total width of 84' back to back of sidewalk. Another major job undertaken by the Department this past year was the reconstruction of the roadway which feeds to Delaware Park Race Track and the General Motors Assembly Plant. On this particular construction we have introduced emulsified carbon black into the concrete at the rate of 1 lb. per bag of cement which gives a direct contrast between sidewalk and curb and the roadway surface. It also reduces glare and heat reflection through the built up areas. As the job went through more heavily populated sections the percentage of carbon black was increased to 2 lbs. per bag of cement. The cross section is 9" of reinforced cement concrete on 6" of select material base with four 11' running lanes and two 8' parking lanes plus sidewalk and curb to give an overall width back to back of sidewalk of 70'. This design was based on the probable covering of the roadway with sheet asphalt at sometime in the future after the life of the concrete as a riding surface has been used. In previous work the sheet asphalt covering has been placed immediately but we feel with the use of the carbon black we can extend the overall life of the construction.

One of our major jobs has been to provide access to new plants and industrial installations which have been moving into Delaware in rapid succession. The duPont Experimental Station has required that we construct the Brandywine Crossing Bridge. The building of the tank arsenal by the Chrysler Motor Company opposite the University of Delaware Agricultural Building has required the construction of several access roads and the Dupont Company's Main Engineering Office Building has been built at a rural location which requires the construction of complete new access facilities. We have used waterbound macadam with hot-mix bituminous surfacing for this type of access work. The thickness of the base is 6" in two 3-inch layers plus three inches of hot mix in one two-inch layer and one one-inch layer with two inches of limestone dust under the stone, then nine inches of select material as subbase. The gradation for this select material is:

Retained on #10 sieve not more than 50%
35-50% Coarse sand (passing #10 sieve and retained on #40 sieve)
10-25% passing #200 Sieve
The fraction passing #40 Sieve shall have a liquid limit not greater than 25 and a plasticity index not exceeding 6

We consider it to be an almost impervious material when properly placed, therefore we carry it only to a point six inches outside of the edge of the roadway and not on a shoulder to shoulder basis as is normally used with pervious material.

We have under construction approximately 40 miles of divided highway, most of which is based on our adopted standard cross-section. This section consists of two 24' roadways with a 50' parkway draining toward the center. The average depth of centerline of parkway being 20" below centerline grade on the outside of each running lane, there is a 10' select material shoulder merging into a ditch section. For this type of roadway, we have developed an alternate section (Fig. 2) using 8" of select material, 1" of stone screenings, 8" of waterbound base and 3-1/4" of hot mix as against 9" of re-inforced concrete on 6" of select material. The bases for this design is the C.B.R. method using 15,000 lbs. wheel road with 20% impact. The depth of the waterbound base is of course a judgment factor from past experience which indicates that two 4" layers can be placed and compacted more successfully than one six layer and also that the added structural strength is required because of inqualities in subgrade material. We have taken several alternate bids on these two sections and the results have indicated that the actual difference will be dependent on freight rates and material prices rather than on differences of design or differences in construction methods. Our alternate bids are not based solely on the differences of cross-section but are developed using these sections individually which indicates differences in excavation quantities, fill quantities, and some cases even lengths and heights of structures.

Because of this method of design, it is unfair to consider differences in price per square yard of finished pavement as the criteria and the truest indication is probably in the cost per mile for the overall finished contract. This price of course varies for the individual jobs but under our present bids have been running between $6,300.00 and $20,000.00 per mile difference on an overall cost of about $240,000 per mile. We are planning to continue the development of this alternate bid method for secondary roads and suburban roads and suburban streets wherever the economics of the situation indicate that either type of pavement will serve. There are of course other locations which definitely indicate that one or the other should be built. One of the recently completed jobs on this alternate bid system is the by-pass around the State Capitol, Dover, (Fig. 3) and the continuation southward on U. S. 13 which carries our Florida bound traffic. There are, of course, varying reactions to the taking of alternate bids and to the design which we have established, but we are satisfied that the design is equitable for our soil conditions and that the bid prices which we have received indicate that they are economically balanced.

Lower Delaware is criss-crossed with tide water streams and a decision had to be made as to whether divided highways should be necked down to one structure or carried on structures built side by side. Our decision, from the safety angle and alignment, was to build two structures (Fig. 4). Typical bridges are on Monotube piling with reinforced concrete deck and superstructure with the load carried by wide flange beams on a span of 45'.

One of the most difficult jobs which we have undertaken for some time has been the reconstruction of Indian River Inlet Bridge. (Fig. 5) The north approach is on timber piling and the south approach which was built similiarly was carried out by ice. The reconstruction is on 110 H-Beam piles with a wrought iron casing filled with concrete from 10" below the bottom to the cap. The H-Beams extend through the concrete. Tides at this location run as high as 15 miles per hour and the ocean is about 100 yards beyond the bridge which allows considerably wave action during storm periods.

Delaware has always been among the leaders in highway planning and

construction and those of us who have inherited the tradition are trying to hold that place, to improve upon it, and to provide highways which are adequate and safe now and in the foreseeable future.

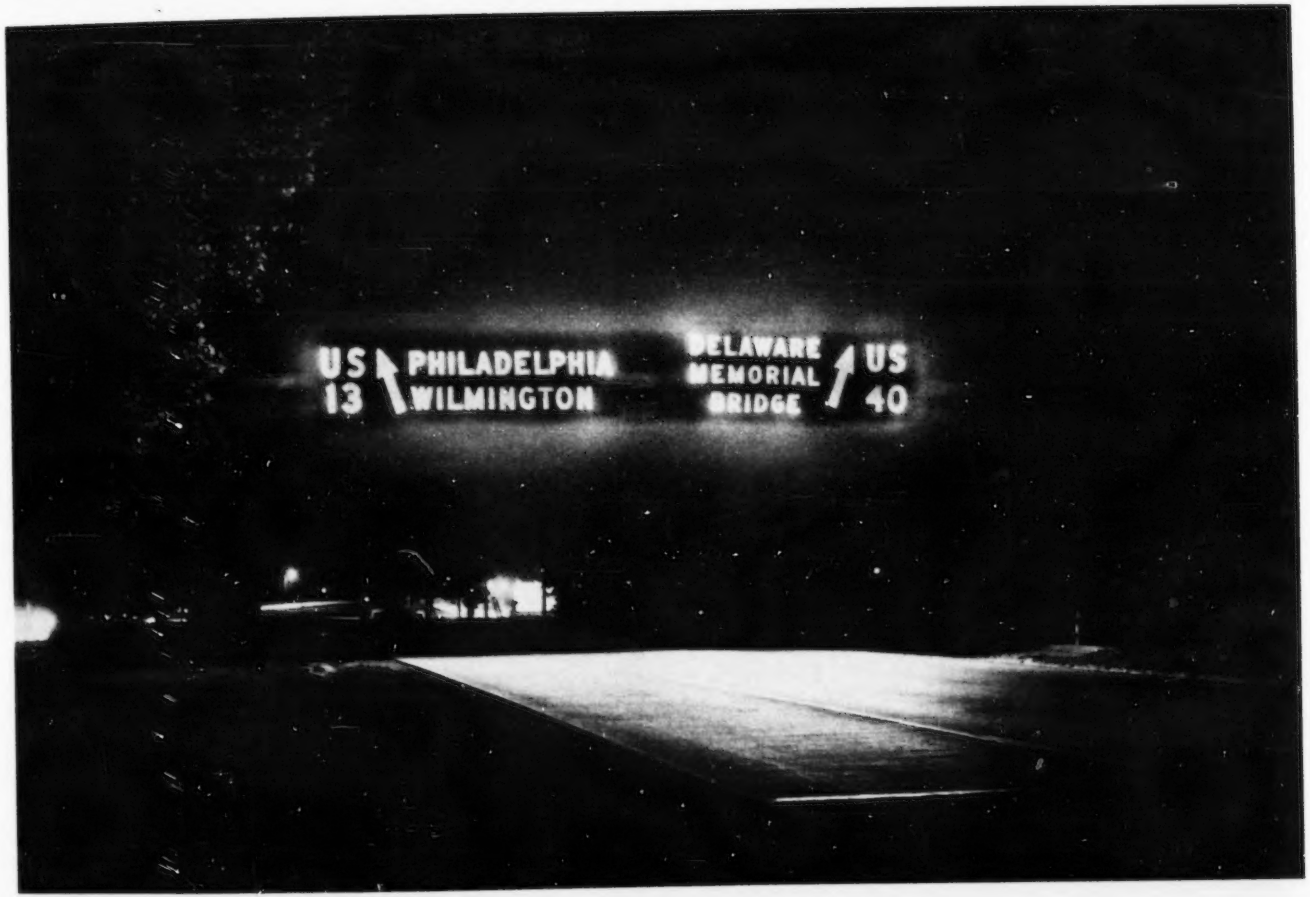
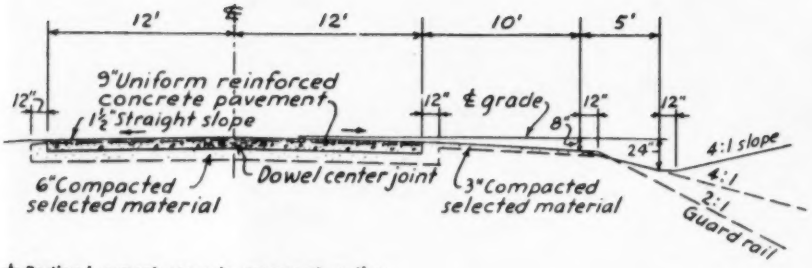
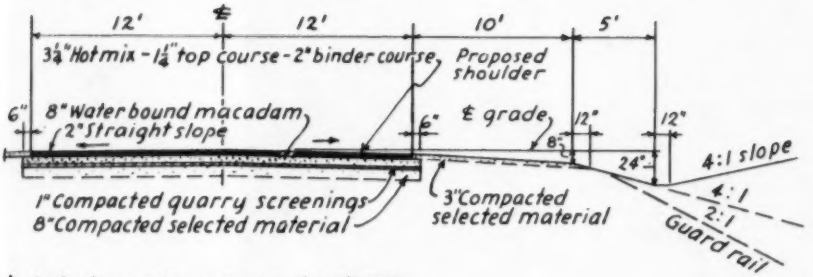


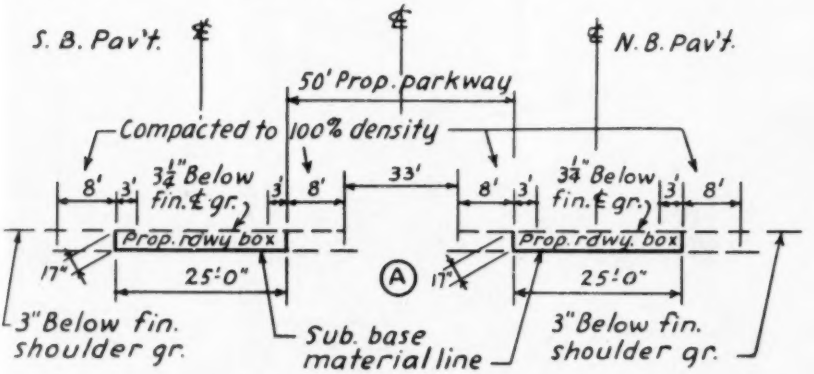
Fig. 1.--Bridge Type Overhead Signs on U.S. 13



★ Portland cement concrete pavement section



★ Asphaltic concrete pavement section alternate



★ Details of subgrade and subbase on which bituminous alternate bids were taken

Fig. 2.--Alternate Sections U. S. 13, Delaware

Fig. 3.--Dover By-pass Looking South From North of St. Jones Bridge

Fig. 4.--Monotube Pile Construction Nanticoke River - U.S. 13, Delaware

Fig. 5.--Reconstructed South Approach, Indian River Inlet, Delaware

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